To: Federal Communications Commission
Comments From: Pulsar Technologies, Inc.
Discussion by: Roger Ray, Co-president of Pulsar, IEEE Fellow, Chairman of the Power Line Carrier Subcommittee of the Power System Communications Committee

In the Matter Of:
ET Docket No. 02-98
RM-9404

Introduction

Pulsar Technologies, Inc. designs and manufactures specialized communications equipment for Electric Utility and Industrial applications. Pulsar manufactures Power Line Carrier, Fiber Optic and Audio Tone equipment for use in control, supervision and protection of the power system. Pulsar has provided this equipment to most investor owned utilities, Co-ops and Municipal utilities, as well as Co-Generators and industrial operations both within in the United States and worldwide.

General comments on:
"A Secondary Allocation for Amateur Operations in the 135.7-137.8 kHz Band."

Pulsar objects to the Commission's proposal to allocate the 135.7-137.8 kHz band to amateur radio operations on a secondary basis. Pulsar would suggest that the benefit to be gained from this type of ARRL activity is far out-weighed by the potential disruption to the utility protection systems through out the United States. These systems have relied on the use of power line carrier as the primary mode of high speed communications for system protection for the past 60 to 70 years. Power line carrier has provided the utility a method of communicating system protection information, which is reliable, fast and cost effective. This holds true today even with the advent of broader bandwidth systems. It is not clear at this time how the allocation of bandwidth to amateur radio experimentation would be a secondary allocation, since power line carrier usage by the electric utilities is an unlicensed service and has for many, many years been sanctioned by the FCC to continue to operate in this manner.

In the past there have been many requests for parts of this band for a licensed service. Undoubtedly there will be future requests. Due to the long term unlicensed use of this band by the utilities, sanctioned by the FCC, shouldn't they be afforded the protection of an official allocation. It is Pulsar's opinion that the FCC should consider setting aside the band from 30 to 500 kHz (except for those areas where there are already licensed services) for use by the utility industry for system control and protection. This could be a broad license such that each individual channel does not need to be licensed. Then the table of frequencies maintained by the UTC could be the documentation of all the channels used under this broad license structure.

Reply to Comments of Mr. W. Lee McVey, P.E.:

Mr. McVey's comment that PLC communication relies on an unfaulted line to propagate information is incorrect. Since the RF energy propagates on all three phases of the power line[1,2], the likelihood of getting a signal to the remote end is high for the most common fault, a single-line-to-ground fault. The single-line-to-ground fault situation comprises 90-95% of all transmission line fault situations. If multi-phase coupling is used, the reliability is even higher. There is also a significant likelihood that some signal will get through the fault for all but the three-phase-to-ground fault, which happens very seldom. Even though the fault causes attenuation of the signal, the overall signal-to-noise ratio is typically adequate to produce a reliable response from the receiver. This is because the noise is also suppressed due to the lower voltage on the transmission line, producing less corona noise. The fault arc itself does not produce noise except for 1 ms or so at fault inception[3].

Mr. McVey comments on the fact that a communications media such as microwave or leased telephone circuits are more reliable because of their lack of path commonality with the power line is incorrect in actual practice. In fact, the entry of a telephone wire into an electric substation is fraught with multiple problems, which many times are not properly addressed by the leasing agency. The problems associated with longitudinal induced voltage and station ground potential rise are well documented in the industry. An excellent example of this documentation is IEEE Standard 367.[4] Microwave is subject to having fade problems from the same sources that cause most faults on power lines, namely heavy rain and lighting. Although Pulsar agrees that fiber optics offers an excellent channel for protective relaying, it is cost prohibitive for the application to system protection alone. Actually if there is no need for wideband information to be transmitted both microwave and fiber optics are cost prohibitive. Power line carrier is an excellent choice from an economic point of view when the utility only has a need to communicate system protection.

The fact that power line carrier is so widely distributed makes it a far more secure method of communications for system protection than a bulk backbone like microwave or fiber optics. By disrupting one power line carrier channel you will disrupt one protection scheme for one transmission line. Most transmission lines have more than one protective scheme applied, and there are generally more than one transmission path for power flow. Thus, in order to disrupt multiple transmission lines one would have to disrupt several power line carrier channels over a wide area at the same time. If a bulk backbone system, that is fiber optic or microwave, is used for protection there will be common paths in the system where many line protection schemes will be communicating through a common "pipe." Even if there is a redundant path, disruption of the bulk communications path in one or two places could knock out the communications path for several protection systems on several transmission lines at the same time, thus making the power grid susceptible to instabilities and shut down. Therefore, in terms of threats from an outside or inside source, power line carrier is far more secure than if we place all of our protection communication on a bulk wideband system, such as, fiber or microwave.

Mr. McVey's comment that microprocessor based protective relays obviate the need for a power line carrier channel or other channel in the transmission line protection scheme is incorrect. Even though microprocessor relays offer many advantages over the older style electro-mechanical relays, the accuracy of the reach of a distance or directional overcurrent element isn't one of them. This is due to the fact that the remote cutoff of the reach of the protective element is a balanced energy point and is susceptible to many system variations, and as a result will not be accurate to the magnitude required. Even modern microprocessor relays need the aid of a communications channel for proper and complete protection of a transmission line.

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[1] Perz, M. C. "Natural Modes of Power Line Carrier on Horizontal Three-Phase Lines", *IEEE Transactions on Power Apparatus and Systems*, Paper No. 63-936. 1963

[2] Perz, M. C. "A Method of Analysis of Power Line Carrier Problems on Three-Phase Lines.", *IEEE Transactions on Power Apparatus and Systems*, Paper No. 63-937. 1963

[3] Udo, Tatsuo & Kawai, Mikio,"*Fault Generated Impulse Noes Voltage in a Transmission Line*",IEEE Transactions on Power Apparatus and Systems, Paper No. 66-384, 1966

[4]ANSI/IEEE Std. 367-R2002, "IEEE Recommended Practice for Determining the Electric Power Station Ground Potertial Rise and Induced Voltage from a Power Fault", 1996